

Application Serial No. 10/579,274
Reply to Office Action of June 14, 2010

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Docket: CU-8471

Amendments to the Claims

The listing of claims presented below replaces all prior versions, and listings, of claims in the application.

Listing of claims:

1. (currently amended) A plug for controlling fluid flow in a well bore at a packer or other sealing element, the plug comprising a substantially cylindrical body adapted for connection to the packer or sealing element, the body including a bore through a portion thereof and a plurality of radial ports for passage of fluid from the bore to an outer surface of the body, an actuating member moveable relative to the body so as to cover each of the plurality of radial ports in a first position and uncover each of the plurality of radial ports in a second position wherein movement of the actuating member is controlled by an actuating mechanism, the mechanism being operable under pressure in the well bore to set the plug in a first natural state wherein the actuating member is in the first position for a pressure under a predetermined pressure range; a second closed state wherein the actuating member is locked in the first position regardless of the pressure in the direction of the plug; and a third open state wherein the actuating member is moved to the second position on increasing the pressure to the predetermined pressure range and holding the pressure in the range for a predetermined time.

2. (original) A plug as claimed in Claim 1 wherein the actuating mechanism comprises one or more pistons operated on by the applied pressure.

3. (original) A plug as claimed in Claim 2 wherein the actuating mechanism comprises first and second pistons; the first piston including a damping element for delaying movement of the first piston relative to the second piston under the applied pressure; the second piston acting on a retaining element; the retaining element adapted to hold the second piston in an intermediate position when the applied pressure is within the predetermined range and allow movement of the first piston to a final position; the retaining element allowing the second piston to move to a secondary position when the applied pressure is above the predetermined range; a locking element which prevents movement of the first piston when the second piston

Application Serial No. 10/579,274
Reply to Office Action of June 14, 2010

PATENT
Docket: CU-8471

is in the secondary position; and a securing element for retaining the actuating member in the first position until released by virtue of the first piston reaching the final position, whereby the actuating member moves to the second position and opens the plug.

4. (original) A plug as claimed in Claim 3 wherein the damping element is a fluid metering device.

5. (previously presented) A plug as claimed in Claim 3 wherein the retaining element is a collet.

6. (original) A plug as claimed in Claim 5 wherein the locking element is a sleeve such that the retaining element and the locking element engage to control movement of the pistons.

7. (previously presented) A plug as claimed in Claim 1 wherein the actuating mechanism comprises a pressure sensor located in the bore to measure the applied pressure, a processor programmed to control a motor in response to the pressure wherein operation of the motor causes the required relative movement between the actuating member and the body.

8. (original) A plug as claimed in Claim 7 wherein the mechanism also comprises a securing element for retaining the actuating member in the first position.

9. (previously presented) A plug as claimed in Claim 1 wherein the actuating member is a sleeve.

10. (previously presented) A plug as claimed in claim 27 wherein the securing element is one or more locking keys which engage with the sleeve.

11. (previously presented) A plug as claimed in Claim 1 wherein the predetermined range for the pressure is approximately 1200 to 1800 psi.

Application Serial No. 10/579,274
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PATENT
Docket: CU-8471

12. – 20. (cancelled)

21. (previously presented) A method of controlling fluid flow in a well bore through a plug operated by an actuating mechanism, the method comprising the steps of:

providing a plug comprising a substantially cylindrical body adapted for connection to a sealing element, the body including a bore through a portion thereof and a plurality of radial ports for passage of fluid from the bore to an outer surface of the body,

providing an actuating member movable relative to the body so as to cover each of the plurality of radial ports in a first position and uncover each of the plurality of radial ports in a second position;

providing an actuating mechanism adapted to move the actuating member; increasing pressure from a surface of the well bore to within a predetermined range; and

keeping the pressure within the predetermined range over sufficient time to cause the actuating mechanism to move the actuating member from the first position to the second position to uncover each of the plurality of radial ports.

22. (cancelled)

23. (previously presented) A method of controlling fluid flow in a well bore as claimed in Claim 21 wherein the method includes the step of applying pressure above the predetermined range.

24. (previously presented) A method of controlling fluid flow in a well bore as claimed in Claim 23 wherein the method includes the step of locking the actuating member in the first position to cover each of the plurality of radial ports when the pressure exceeds the predetermined range.

25. (previously presented) A method of controlling fluid flow in a well bore as claimed in Claim 21 wherein the method includes the step of performing a pressure test above the plug.

Application Serial No. 10/579,274
Reply to Office Action of June 14, 2010

PATENT
Docket: CU-8471

26. (previously presented) A method of controlling fluid flow in a well bore as claimed in Claim 24 wherein the method includes the step of bringing the pressure back down to below the predetermined range, increasing the pressure from a surface of the well bore to within the predetermined range, and keeping the pressure within the predetermined range to cause the actuating member to move from the locked first position to the second position to uncover each of the plurality of radial ports.

27. (previously presented) A plug as claimed in Claim 8 wherein the actuating member is a sleeve.